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ABSTRACT

The study compared the effect of two training methods on pre- and post-student teachers' use of pedagogical moves in teaching. One treatment group classified moves from two videotaped lessons while the other group classified moves from the typewritten transcripts of the videotaped lessons. The frequency of moves used by the student teachers was determined from classroom observation analysis of two microlessons--one prior to treatment on parallelograms; one after treatment on rhombus. The findings indicated significant increase in the mean number of total moves and concept specific moves for all subjects between microlessons. Post-student teachers showed significant mean increase in the number of total moves but the pre-student teachers did not. There were no significant differences found between treatment groups. (JG)

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The Effect on Teaching Performance of Two Training Techniques in the Knowledge of Concept Moves

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Teaching concepts is of primary importance to mathematics teachers for concepts serve as a foundation from which generalizations and rules of procedure are built. Henderson (1970) has developed a pedagogical model which explicates logical moves that teachers can utilize in teaching mathematical concepts. A question of interest to those involved in training prospective mathematics teachers is the extent to which this model can serve a useful purpose in training teachers.

THE STUDY

Statement of the Problem

The main purpose of this study was to compare the effects on teaching performance of two treatments involving knowledge of moves in teaching concepts as discussed by Henderson (1970). Pre-service teachers enrolled as mathematics education students at the University of Georgia served as subjects. The subjects were divided into pre- and post-student teachers and then randomly assigned to two treatments. Two microteaching sessions, one before and one after treatments (Teach I and Teach II), were used to identify various moves in teaching the concepts of parallelogram and rhombus. The microteaching sessions were approximately 15-20 minutes in length.

Hypotheses. Specifically the following hypotheses, stated in the null form, were examined:

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1. The pre-student teacher group and post-student teacher group do not differ significantly in the mean increase in the number of moves from Teach I to Teach II (G effect).
2. The subjects in Treatment I and the subjects in Treatment II do not differ significantly in the mean increase in number of moves from Teach I to Teach II (T effect).
3. The mean increase in the number of moves from Teach I to Teach II^v does not differ for the pre- and post-student teacher groups across Treatments I and II. (GT interaction)
4. There is no significant difference between the mean number of moves used by all subjects in Teach I compared to the mean number used in Teach II.
5. There is no significant difference between the mean number of moves used by the pre-student teachers in Teach I compared to the mean number used in Teach II.
6. There is no significant difference between the mean number of moves used by the post-student teachers in Teach I compared to the mean number used in Teach II.

The Subjects

Undergraduate students enrolled in three mathematics education courses at the University of Georgia during the Spring Quarter, 1971, served as subjects. Two of the courses, a curriculum course (¹⁵~~23~~ students) and a methods course (8 students) are designed to prepare the undergraduates for their student teaching experience. The third course is a post-student teaching seminar (16 students) which, among other topics, deals with problems that students encounter during their student teaching experience. The subjects in the curriculum course had no teaching experience prior to this study. The teaching experience of the subjects in the methods course consisted of a week and a half of tutoring students individually. All of the subjects in the seminar course had just completed their student teaching during the Winter Quarter, 1971. The curriculum course and the methods course were combined into one group, the pre-student teachers, and the seminar course made up the post-student teacher group.

The seventh grade students that participated in the microteaching sessions were students at a local junior high school. It was not felt necessary to obtain statistical data for those students since they were not tested over the content of their microlesson. The junior high school students' regular mathematics teacher selected the students that would participate in each lesson.

Only those subjects with complete data on both microteaching sessions were included in the data analysis. Two of the subjects in the pre-student teacher group were excluded from the data analysis because of the poor quality of their audio recordings. One other subject (pre-student teacher) was excluded from the analysis after checking for outlying observations. A procedure outlined by (Li, 1964, pg. 548) was used as a method for deciding to delete this observation. Hence, the number of subjects used in the data analysis was 20 pre-student teachers and 16 post-student teachers.

Procedure

All of the subjects prepared and taught a microlesson on parallelograms" to three seventh grade students on April 6, 1971. To prepare the subjects for Teach I, the investigator met with each mathematics education class to give a brief overview of the study and explain the subjects' role in the study. At this meeting each subject was given the content of his lesson, the procedure, and two objectives for Teach I. The content and objectives were described in general, non-behavioral terms to allow each subject some latitude in planning their lesson. All of the subjects had at least one week to prepare their lesson on parallelograms for Teach I.

Following Teach I, the treatment sessions began. They lasted from Monday, April 12, to Friday, April 16. The investigator spent one hour a

day for these five days introducing the subjects to moves that can be used in a concept venture and classifying moves used in a concept venture.

After the treatment sessions, all of the subjects taught a second microlesson to three seventh grade students. The second microlesson occurred on April 20, 1971. The seventh grade students that participated in Teach II were the same students that participated in Teach I. However, each subject did not necessarily teach the same students he had taught in Teach I. All of the subjects were told, on the final day of the treatment sessions, they would teach the concept of rhombus in Teach II. The subjects were told also that the same set of objectives for Teach I were to be applied for Teach II which allowed the subjects as much freedom as possible in preparing their lesson.

Descriptions of Treatments

The treatments consisted of five one hour sessions, one session per day. All sessions were conducted by the principal investigator. The first three sessions were common to each treatment group. The first session began with a discussion on the importance of teaching mathematical concepts. Two aspects of concepts were then discussed, viz., the term denoting the concept and the referent set of the term. Moves in teaching concepts, as explicated by Henderson, were then discussed and analyzed. The students were given mimeographed sheets stating and exemplifying the moves. The second session began with a review of the first days discussion. To facilitate the subjects learning the terms associated with the moves, the terms were reviewed and the examples on the mimeographed sheets were read and discussed. The third session consisted of the investigator reading examples of moves and asking students to identify

the moves. Criteria for distinguishing various moves were also given.

In the last two sessions, the subjects in Treatment I viewed two 15 minute videotaped lessons on prime numbers and congruent polygons (one lesson per day) and classified moves from the lessons. The subjects in Treatment II classified moves from the typewritten transcripts made from the videotapes. Subjects in both treatments were asked: (1) Do you think the moves in the lesson were effective? and, (2) What other moves could be used?

Carefully constructed lesson plans were used for all sessions to insure uniformity of lessons for the 1st three sessions and to insure parallel treatments in the last two training sessions. At the end of the fifth session a ten item test was given to both treatment groups to test the subjects ability to classify moves.

Sources and Types of Data

All microteaching sessions for Teach I and Teach II were audiotaped. Every tape was analyzed for moves that occurred during the lesson and each move was recorded. The investigators made a distinction between the moves that dealt directly with the concept being taught (parallelogram or rhombus) and those that were not. For example, consider the following dialogue taken from one of the tapes:

Teacher: What is a polygon?

Student: It is closed, many sided figures where the sides are all straight lines.

Teacher: Good! Well, a parallelogram is a special kind of polygon.

In this dialogue, the student used the move of identification and the teacher followed with a classification move. The student identified a polygon which

was not the concept being taught. However, the teacher's classification move dealt directly with the concept of parallelogram.

After the moves were recorded, the investigators counted all of the moves used in the concept venture. This number indicated the total number of moves used. The number of moves that dealt directly with the concept being taught were also recorded. The total number of moves and the number of moves dealing directly with the concept served as the data. This data was obtained for both Teach I and Teach II.

Observer Reliability

To validate the moves identified by the principal investigator, a random sample of twelve audiotapes from Teach I and ten from Teach II (72 microteaching sessions in all) were selected to be reviewed by two experienced observers, one of which was the other investigator. The observers analyzed the tapes (11 tapes per observer) and recorded moves as they occurred. These moves were then compared with those recorded by the principal investigator. Even though only the number of moves were used as data, the classification of a move was not considered to be in agreement unless the observers identified the same specific move as the principal investigator. For example, if one observer recorded a particular move as a characteristic move while the principal investigator recorded it as a classification move, this move was not considered to be in agreement.

An index of agreement was obtained by using the following formula:

$$\text{Index of agreement} = \frac{2x (\text{number of moves agreed upon})}{(\text{Observer total}) + (\text{Investigator total})}$$

Indices were obtained for both total moves and moves related directly to the concept being taught. For the 22 measures relating to total moves, a median rating of .81 was obtained. For the 22 measures relating to moves directly related to the concept being taught, a median rating of .86 was obtained.

Data Analysis

To test Hypotheses 1, 2, and 3, ANOVA techniques were utilized. The data gathered for the analysis of variance was classified with reference to a classificational and a treatment variable. The subjects were classified with respect to two groups (G) and two treatments (T). G consisted of pre- and post-student teachers. To test for the significance of the G effect, T effect, and the GT interaction, difference scores between the first and second microteaching sessions for each subject were obtained. These difference scores were then used in a two-factor analysis of variance design. A difference score of 29 would indicate that a subject used 29 more moves in the second microlesson than in the first microlesson.

The number of observations in the four cells were proportional. There were ten pre-student teachers in Treatment I and ten in Treatment II. The post-student teachers numbered eight in Treatment I and eight in Treatment II. To compute the F ratios for the two-factor ANOVA with proportional cell frequencies, the appropriate computational formulas were taken from Statistical Methods in Education and Psychology (Glass and Stanley, 1970, pp. 436-37).

T-tests were used to test Hypotheses 4, 5, and 6. The data gathered for the t-tests was composed of pairs of observations for a single group of subjects. Each subject had a score corresponding to the number of moves occurring in Teach I and a score corresponding to the number of moves occurring in Teach II. The observation from the first microteaching session was paired with the observation from the second microteaching session for each subject, and a difference between each pair was obtained. The test for significance was concerned with comparing the difference between two means for correlated samples. The following statistic was used (Ferguson, 1966, p. 170):

$$t = \frac{\sum D}{\sqrt{\frac{N \sum D^2 - (\sum D)^2}{N - 1}}}$$

where D denotes the difference obtained between each paired observation, and N denotes the number of paired observations.

RESULTS

The mean score for the ten-item test which tested the subjects ability to classify moves was 9.2 . This result indicated that the subjects did have a knowledge of a model for teaching concepts in that they could classify moves. The remainder of the results are reported in two sections, the first dealing with the total number of moves and the second dealing with moves related directly to the concept being taught.

Analysis of the Total Number of Moves

The mean difference scores that were obtained for treatments by groups is given in Table 1.

TABLE 1
MEANS FOR TREATMENTS BY GROUPS

GROUPS	MEANS	
	Treatment I	Treatment II
Pre-Student Teachers	9.6	-0.8
Post-Student Teachers	11.875	13.25

Table 2 contains a summary of the two-factor ANOVA for the two factors on the difference scores between Teach II and Teach I with respect to the total number of moves used in the microlessons. The group and treatment effects were not found to be significant at the .05 level. Null hypotheses 1 and 2 (for total moves) were, therefore, not rejected.

TABLE 2
ANOVA FOR THE DIFFERENCE SCORES

Source of Variation	d.f	SS	MS	F
Between Subjects				
Groups (G)	1	592.235	592.235	1.827
Treatments (T)	1	240.250	240.250	.741
GT	1	308.112	308.112	.950
Subjects w. groups	32	10374.375	324.199	
Total	35	11514.912		

Even though the GT interaction was not significant, there is a trend that is worth noting. Treatment I seemed to be more effective for the pre-student teacher group than did Treatment II. The effect of the treatments on the post-student teachers was about the same.

A t-test was performed on the difference scores between Teach II and Teach I for all subjects. This analysis revealed a significant difference between the Teach I mean and the Teach II mean at the .05 level ($t = 2.655$, 35d.f.) . Hence, Hypothesis 4 is rejected (for total moves). The analysis indicated that the mean number of total moves occurring in the second micro-

lesson was significantly more than the mean number occurring in the first microlesson.

A nonsignificant t value ($t = 1.238$, 19d.f.) was obtained using the difference scores between Teach II and Teach I for the pre-student teacher group. Hence, Hypothesis 5 was not rejected.

The t -test performed on the difference scores between Teach II and Teach I for the post-student teacher group resulted in a t value of 2.488 (15d.f.) which was significant at the .05 level. This analysis indicated that for the post-student teachers there was a significant gain in the mean number of total moves from Teach I to Teach II. Therefore, Hypothesis 6 was rejected.

Analysis of the Moves Dealing Directly with the Concept Being Taught

As with the data corresponding to the total moves, analysis of variance was performed on the difference scores between Teach II and Teach I. Mean difference scores are given in Table 3.

TABLE 3
MEANS FOR TREATMENT BY GROUPS

GROUPS	MEANS	
	Treatment I	Treatment II
Pre-Student Teachers	1.3	4.9
Post-Student Teachers	5.125	1.375

Table 4 contains a summary of the two-factor ANOVA for the two factors on the number of moves used that dealt directly with the concept being taught

in the microlessons. The group and treatment effects were not found to be significant at the .05 level. Therefore, Hypotheses 1 and 2 were not rejected for concept specific moves. The GT interaction was not significant at the .05 level. Hence, Hypothesis 3 was not rejected.

TABLE 4
ANOVA FOR THE DIFFERENCE SCORES

Source of Variation	d.f.	SS	MS	F
Between Subjects				
Groups (G)	1	.20	.20	.002
Treatments (T)	1	1.00	1.00	.012
GT	1	120.05	120.05	1.414
Subjects w. groups	32	2717.75	84.93	
Total	35	2839.00		

A significant t value (.05 level) of 2.110 (35d.f.) was obtained using the difference scores for all subjects on concept specific moves. Hence, Hypothesis 4 was rejected. This indicates that the mean number of concept specific moves increased significantly from the first microlesson to the second microlesson.

The t-test performed on the difference scores between Teach II and Teach I for the pre-student teacher group resulted in a nonsignificant t value of 1.693 (19d.f.) . Hence, Hypothesis 5 was not rejected for concept specific moves

The t value obtained using the difference scores between Teach II and

Teach I for the post-student teacher group was nonsignificant ($t = 1.273$, $d.f. = 15$) . Thus, for moves related directly to the concept, Hypothesis 6 was not rejected.

DISCUSSION

The results indicated that there was a significant increase (at the .05 level) in the mean number of total moves and concept specific moves for all subjects from Teach I to Teach II (Hypothesis 4) . The mean increase in total moves from Teach I to Teach II for the post-student teacher group (Hypothesis 6) was also significant (.05 level) . All other Hypothesis were not rejected.

The possibility of having treatments that were not sharply contrasted might explain the nonsignificant results in the ANOVA tests. The only difference in treatments occurred on the last two days of the treatment sessions, the first three sessions being exactly alike for both treatments. Had the differentiated part of the treatments been extended, it is possible that the modeling affect of the videotapes might have had more of an affect on the result of the second microlesson.

The major finding of this study was that for all subjects there was a mean increase in number of moves from Teach I. One can conjecture that this mean increase is due to the fact that a different concept was taught in the second microteaching session. However, it can be argued that the concepts of parallelogram and rhombus are equally rich in the kinds of moves that can be employed.

Another possible explanation for the mean increase in number of moves from the first to the second microlesson is the artifact of students asking questions. The more questions that are asked by students, the more likely

that moves will occur. However, since students were randomly assigned to the microteaching sessions, the artifact of students asking questions does not seem to explain this finding.

A second opportunity to teach a microlesson might also explain the mean increase in number of moves. However, teaching experience does not appear to be a deciding factor since the post-student teachers had an increase in moves from Teach I to Teach II. These students had student teaching experience and some previous experience with microteaching and in the teaching of concepts.

It would seem, then, that the training sessions were an influential factor in accounting for the increase in moves used by the subjects from Teach I to Teach II. The data does not indicate a differential effect for the two treatments.

The training sessions did not have a significant effect on the pre-student teacher group but did have an effect on the post-student teacher group with respect to total moves. This indicates that the material presented had more relevance for the post-student teachers because of their previous teaching experience, which suggests that the type of training provided in the experiment may be more effective after the pre-service teacher has had some experience in teaching.

If replications of this study further substantiate that training involving the knowledge of concept moves can increase the moves that teachers use, what is the effect of this increase on student learning? Preliminary investigations by Swank* indicate that teachers who are rated highly by impartial observers tend to use more concept moves than teachers given lower ratings. This gives some support to the conjecture that using more moves in a lesson may be beneficial to student achievement. However, until evidence is found

*Information received in personal communication with Dr. Earl Swank concerning research in progress.

relating moves to student achievement, we can only conjecture as to the value of training pre-service teachers in the use of concept moves.

The present study has demonstrated some effectiveness of training pre-service teachers in knowledge about a pedagogical model for teaching concepts. It is hoped that additional research will refine these results, and more appropriate teacher training procedures will be discovered.

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